Teacher Behaviors As Related to the Process Learning Sequence

If the teacher behaviors we have discussed are viewed in the context of the process learning sequence (from the intuitive, through the awareness, to the functional stages of growth), each behavior may be related to the stage of a student's development it most directly influences.

The teacher behaviors of the diagnostic set are not included in this chart because their main purpose is to provide data for the teacher rather than to directly influence the student's growth in a predetermined, predictable way.

	Intuitive Level	Awareness Level	Functional Level
The Conditions Set			
Focus Setting	✓		
Structuring	✓		
Clarifying	✓		
Accepting	✓		
Responding to Student's Data Probe	✓		
Teacher Silence	✓		
The Growth Set			
The Process Support Sequence — Probe for Data	✓	✓	
The Process Support Sequence — Probe for Operations	✓	✓	
The Process Support Sequence — Suggesting an Operation	✓		
The Process Support Sequence — Designing Operations	✓		
Identifying Inquiry Processes		✓	
Identifying Products of Inquiry		✓	
Probe for Intent or Function			✓
Probe for Prediction or Explanation			✓

The Process Dialogue

If students are to learn to read, whatever else they do, they should read. But learning to read involves more than having a book in hand. Dialogue between the students and their teacher about what they have read is also important. The students discuss words they didn't know and meanings they were able to figure out for themselves. In learning to read, then, the students spend most of their time reading and some of their time in an open dialogue with their teacher and other students.

The same is true of students learning to inquire. They spend most of their lesson time working to solve problems suitable for their inquiry and some of their time in a dialogue about what they did as they worked, what they learned about solving problems, the difficulties they encountered, and what they plan to do differently when they work on their next problem.

The inquiry activity is organized into these two discrete parts because of the way people think and work comfortably. When anyone is caught up in working to solve a problem, it is difficult for him to interrupt his thinking to discuss something else. Ideal times for process dialogue, therefore, are as students prepare to work, when ways of working are likely to be a prime concern, and when work on the problem has stopped, either because the problem has been solved (and another productive strategy thus discovered) or because the inquirers have "run dry" and need help from others.

The process dialogue is a group activity, while the actual inquiry is an individual effort. The opportunity to tell others about how he has worked forces each student to conceptualize what he has done. The dialogue raises new issues for the students' consideration and provides new alternatives for exploration by all those involved in the discussion.

As the students' ability to discuss various theory-seeking and theory-testing strategies grows, each inquiry problem becomes an opportunity to explore new strategies they have formulated.

Presession process dialogue:
Students *theorize* about theory-seeking and/or theory-testing strategies they want to try.

Work on the problem:
Students *test out* the strategies they have formulated.

Postsession process dialogue:
Students *evaluate* the theory-seeking and/or theory-testing strategies they used, identify advantages, and suggest revisions for next time.

Illustrative Questions for the Process Dialogue

Frequently students will raise questions that are excellent topics for discussion. The teacher must provide the time and "legitimate" status leading to a productive discussion of them. If necessary, he can supplement the questions and issues raised by the students with a few of his own. The following examples may be used to stimulate thought and action by students at several age levels. The teacher should choose those he finds most appropriate.

General Strategy Questions

How do you decide what to do as you work on a problem?

How do you know when a problem is solved?

Theory-Seeking Questions

What can you do to get started on a new problem when you don't have a theory?

When you don't have a theory and you want to get started by generating data, how do you decide what data to get?

When you've started work on a problem by generating data—in search of a theory—how do you decide which data are important and which can be forgotten? (consequential variables)

Theory-Testing Questions

Once you have a theory, how might you go about testing it to find out if it is a good one?

When you have more than one theory to explain the same thing, how can you find out which one is better (more powerful)?

Do any of you have a theory you think is a good one in relation to the problem we've been working on? How do you know?

Do any of you have a theory you feel is no good—or that you want to think about some more? How did you decide it was no good?

Questions About Data and Data-Generating, Data-Organizing, and Data-Using Processes

What are data?

What good are data?

What are good data?

How do you decide what data you need as you work on a problem?

How do you decide what you will do to get the data you feel you need?

What are some different ways to generate data? How do you decide which one to use?

When—under what conditions—would you experiment to generate data?

How is an experiment different from a verification operation?

What can you do to make certain that the data you get are good data?

How do you know whether or not you need to organize your data?

How do you decide how you'll organize your data?

In what ways do you use data?

How do you decide what the data you get mean in relation to your theory?

How do you decide what your theory will and will not predict?

How do you know when to discard a theory? On what basis?

How do you decide how to revise a theory?

In what ways are theories related to data?

Questions About Theories and Theory-Using Processes

What is a theory?

Is there any difference between a theory and someone's opinion?

What is a good theory?

Can you ever know for sure if a theory is "right"? Can you ever prove a theory true? Under what conditions? What kinds of theories?

What good is a theory?

What are some ways you use a theory?

How do you use a theory (or theories) to build an explanation?

Postsession Questions

What will you do differently next time we work?

Have you learned anything new about working on problems from your work today?

Does anyone have anything to add to the chart of problem-solving strategies? Is there anything you'd like to change?

Did anyone try . . . (referring to a strategy outlined on the chart of problem-solving strategies) as you worked today? How did it work for you?

How do you decide which problems are inquirable and which are not?

How is your work on this problem similar to (or different from) your work on . . . problem? (problems of the same and different content areas)

The critical issue in the process of education is not whether all teachers should teach toward the same objectives. It is, rather, how all teachers can come to know what objectives they seek and how best to attain them.

The importance of objectives in instruction has been stated often over the years. Many educators agree that good teaching *must* be directed toward specified purposes. We have, therefore, developed goals and objectives both for the student who is increasing his power as an inquirer and for the teacher who is sharpening his ability to teach toward inquiry.

Some in the educational enterprise view objectives as mechanical decorations set forth to satisfy a required way of stating the curriculum, but serving no useful purpose. Indeed, some statements of objectives are so vague and nebulous that it is quite understandable that this notion should exist. The reverse—simplistic, narrowly stated behavioral objectives—causes an equally adverse reaction from the thoughtful, creative teacher. But statements of objectives need not be ornaments in a formally stated curriculum, nor a brake on creativity and independence. Rather, if carefully and precisely phrased they provide *guidance* for the student, teacher, administrator, budget analyst, and consultant—indeed, for all involved in instructional decision making.

Useful objectives, carefully and precisely stated, provide guidance in—

Selection of Content

As used here, *content* refers to process as well as to information from a body of knowledge. Guidance to the teacher in the selection of content to be emphasized in the teaching/learning situation is given in the "content dimension" of an objective. For example, with an objective such as "Uses a range of theory-seeking and theory-testing strategies as he works on problems of different content areas," the content called for is "theory-seeking and theory-testing" (process content) in "problems of different content areas" (knowledge content).

Identification of Student Behavior Sought

A carefully stated objective includes some reference to the behavior sought in the teaching/learning situation. With the content, "a range of strategies as he works on problems of different content areas," what is it we wish the student to do? Do we want him to be able to *recall* a range of strategies? Do we want him to *identify* a range of strategies that he and others in the class have used? We want him to *use* a a range of theory-seeking and theory-testing strategies as he works on problems of different content areas. What the student is to *do* is the behavioral dimension of the objective. Specifying the behavior in an objective facilitates putting in sequence the student behaviors sought, from entering to complex practiced behavior.

Selection of a Teaching Strategy

An objective that contains a precise statement of the student behaviors sought guides the teacher in the selection of relevant learning opportunities: how students are to work, what they are supposed to learn, what materials will be used, and how they will be organized for learning. Obviously, if a student is to develop a particular behavior there must be opportunities for him to practice this behavior—to "do" the behavior outlined in the objective.

Evaluation of Change in Student Behavior

To prevent haphazard evaluation, precisely stated objectives are crucial. The specification of an objective such as "Groups two or more inquiry processes into a sequence to build or test a theory" requires assessing progress on this specific behavior. Without objectives clearly in mind, the tendency of the teacher may be to evaluate the student's growth only on the basis of his ability to recall, rather than on a range of more highly valued behaviors.

A carefully stated objective is useful also to the students. When students are aware of the objectives that underlie instruction, these objectives serve as one kind of benchmark for them, so they can see where they have been, where they are, and where it is possible for them to go.

Evaluation of Teacher Behavior

In addition to serving as criteria for evaluation of student growth, objectives for instruction may help a teacher evaluate his own behavior. Change or lack of anticipated change in the behavior of some students becomes a base from which inferences may be drawn about the effect of the teacher's instructional behavior on the entire class. If his behavior did not facilitate student growth, what alternative ways of working are open to him?

Goal Level I
Getting Involved

At Goal Level I, the student enters the inquiry activity through apparently random generating of data and presenting of his ideas or theories in relation to the problem. He experiences both the frustrations of trying to solve a problem on his own and the exhilaration of becoming increasingly productive in building explanations that match the data he or others in the group generate.

Goals for Students Learning To Inquire

One of the goals of education as we see it is to help students become more productive, systematic, and autonomous problem solvers. When students solve problems on their own, as opposed to having the teacher either directly or indirectly solve them, the students are inquiring.

If inquiry-oriented teaching is different from the development of a certain body of content or from having the students practice certain skills, how does a teacher tell whether his teaching is effective? Toward what objectives is inquiry-oriented teaching directed? How do students behave differently as they get better at inquiring?

Goal Level II
Exploring the Tools of the Inquirer

At Goal Level II, the student uses his theories as a point of departure for his inquiry. He is able to label the data-generating processes he uses. Thus, these processes become discrete elements of his conscious behavior which he is able to talk about. He also begins to use data-organizing and data-using processes as he works.

Goal Level III
Developing a Repertoire of Inquiry Processes

At Goal Level III, the student knows what specific information he needs in order to substantiate the theory(ies) on which he is working. He translates this need for information into data-generating processes, and then into data-organizing, data-using, and theory-using processes.

Goal Level IV
Developing a Repertoire of Inquiry Strategies

At Goal Level IV, the student's us of theory-using processes gives rise t the emergence of a repertoire o theory-testing strategies. Using con cepts of objects, systems of objects conditions, events, people, places and/or feelings leads to the eme gence of theory-seeking strategies.

Goal Level V
More Autonomous Inquiry

At Goal Level V, the student's in quiry is essentially internally motivate and voluntarily implemented. A typica teacher–student relationship no longe exists during the inquiry activity. Th teacher's major role with a studen who works at this level is to suppo his inquiry by giving him time to wo and by facilitating his generation o data.

Illustrative Objectives for Students

The objectives we will identify for students learning to inquire will be classified according to the five goal levels just listed. These objectives become one basis for making decisions about student growth.

Each time a student works on a problem it is possible to relate his work to our taxonomy of objectives. However, his behavior will usually be found to range over several goal levels. The problem then is to determine the goal level at which a student is working. Goal attainment for a student may be assumed when *most* of his behavior can be ascribed to the objectives for a given goal. The objectives we are about to identify do not include the conditions under which the student should attain them, nor do they specify how well the student should perform. The inclusion of these two elements would, of course, make the objectives more specific. By design they have *not* been stated because they cannot be identified apart from an individual teacher's teaching situation and value system.

Our objectives have been formulated so that they relate to the student's work in any content area and to his participation in the process dialogue.

The objectives we have identified are not the only ones to be attained. Rather, they are the *priority* objectives in teaching toward inquiry. It is quite possible and perhaps even desirable to specify at each goal level an array of additional objectives appropriate for a particular group of students. Certainly any teacher engaged in professional inquiry—his own inquiry into teaching toward inquiry—will identify restatements to be formulated and additions to be made.

Illustrative Objectives for Students Learning To Inquire

Goal Level I Getting Involved	Goal Level II Exploring the Tools of the Inquirer	Goal Level III Developing a Repertoire of Inquiry Processes	Goal Level IV Developing a Repertoire of Inquiry Strategies	Goal Level V More Autonomous Inquiry
Makes a comment or poses a question about the structure of the inquiry activity				
Works to solve problems presented to him by the teacher	**Suggests** a subproblem of his own while working on a problem presented by the teacher	**Suggests** a problem of his own related to the specific content of other-than-inquiry classroom work	**Suggests** a problem of his own unrelated to the specific content of other-than-inquiry classroom work	*
Uses data-generating processes	**Uses** data-generating, data-organizing, and data-using processes	**Uses** data-generating, data-organizing, data-using, and theory-using processes	**Uses** data-generating, data-organizing, data-using, theory-using, and data-validating processes	*
	Labels the specific data-generating processes he uses	**Labels** the specific data-generating, data-organizing, and data-using processes he uses	**Labels** the specific data-generating, data-organizing, data-using, and theory-using processes he uses	**Labels** the specific data-generating, data-organizing, data-using, theory-using, and data-validating processes he uses
		Uses a wide range of data-generating processes during the course of his work on different problems	**Uses** a wide range of data-generating, data-organizing, and data-using processes during the course of his work on different problems	**Uses** a wide range of data-generating, data-organizing, data-using, and theory-using processes during the course of his work on different problems
		Formulates data-generating processes that include all relevent information about such factors as time, weight, condition, location, etc.	*	*
	Labels the products of his inquiry as data or theory	**Reports** the function of data and/or theory in his inquiry	*	*
	Responds to other students who wish to discuss their theory(ies) with him	*	*	*
Initiates action to engage others in a dialogue about the problem	**Initiates** action to engage others in a dialogue about his theory(ies)	**Uses** other students' data and theories in his work on a problem	*	*

Four

Objectives in Inquiry

Tests his theories only when helped by a DESIGNING OPERATIONS FOR STUDENTS teacher behavior	**Tests** his theories only when helped by a NAMING OPERATIONS teacher behavior	**Tests** his theories only when helped by a PROBE FOR DATA teacher behavior	**Tests** his theories only when helped by a PROBE FOR OPERATIONS teacher behavior	**Tests** his theories with no help from the teacher
States a problem solution using a theory for which he cites no supportive data	**States** a problem solution using a theory for which he cites one piece of supportive data	**States** a problem solution using a theory for which he cites a generalized set of supportive data	**States** a problem solution using multiple theories for which he cites multiple generalized sets of supportive data	**States** a problem solution using a theory for which he cites multiple generalized sets of supportive data
	Rejects his theory when confronted with one piece of nonsupportive data	**Rejects** his theory only when confronted with a generalized set of nonsupportive data	**Rebuilds** or refines his theory to accommodate nonsupportive data where appropriate	**Persists** in working on a problem until he is satisfied with a successful solution
			Holds in abeyance a theory for which no data can be generated	*
	Generates data about objects, systems of objects, events, conditions, people, places, and feelings, over the course of his inquiry in different content areas	**Classifies** data as data about objects, systems of objects, events, conditions, people, places, or feelings	**Uses** the concepts of objects, events, systems of objects, conditions, people places, and feelings as a base from which to systematically generate data when he works in search of a theory	*
		Reports theory-seeking strategies he has used	**Prescribes and uses** a theory-seeking strategy	**Prescribes and uses** a range of theory-seeking strategies as he works on problems of different content areas
		Reports theory-testing strategies he has used	**Prescribes and uses** a theory-testing strategy	**Prescribes and uses** a range of theory-testing strategies as he works on problems of different content areas
Reports intense feelings of frustration at not being told which theory is the "correct" one	**Reports** moderate feelings of frustration at not being told which theory is the "correct" one	**Reports** positive feelings because he is able to determine which theory is "correct" for himself	**Reports enthusiastically** his positive feelings about inquiry because of his power to test theories for himself	**Demonstrates** his valuing of inquiry as a way of dealing with problems as he (1) uses inquiry as a base for accepting theories, (2) encourages his friends to use inquiry as a way of solving their problems, and/or (3) tells others why he feels inquiry is important to him
	Requests additional classroom inquiry activities in content areas already used for inquiry in the classroom	**Requests** classroom inquiry in a content area not previously dealt with in the classroom	**Requests** opportunities to continue working on a problem situation he has previously worked on	**Seeks** opportunities to inquire in all discipline areas as well as in suitable personal problems
Attends to a dialogue of other students about their participation in an inquiry activity	**Participates** in a group dialogue about the inquiry activity	**Participates** in a group dialogue about inquiry processes	**Participates** in a group dialogue about inquiry strategies	*

Goals for Teachers Learning To Teach Toward Inquiry

Goals for teachers who are sharpening their effectiveness in teaching toward inquiry specify in a developmental way what the teachers must be able to do as they work with their students. These goals are based on the premise that the teacher is willing to participate in an in-service series designed to help him improve his ability to teach toward inquiry. In this instance "is willing" means the teacher agrees to—

Experiment with ways of organizing the classroom and the students.

Experiment with ways of behaving toward process goals.

Use problem situations in the classroom for which his preparation is required.

Let other adults in the group listen to him interacting with his students.

Goal Level I
Reading the Students' Inquiry Behavior

At Goal Level I the teacher is able to classify two groups of inquiry processes used by students as they work: data-generating and data-using processes. He is also able to relate these processes to the data-theory loop model of inquiry in order to reveal ways in which the processes are interrelated.

Goal Level II
Creating the Classroom Conditions for Inquiry

At Goal Level II the teacher is able to create the conditions for inquiry in the classroom. He is able to arrange things so that students have the opportunity to work on a problem, have the freedom to seek out the information they want, when they want it, and have an environment where information is available to them when they seek it without judgment on the results. He is also able to classify the students' data-organizing and theory-using operations.

Goal Level III
Facilitating the Students' Growth as Inquirers

At Goal Level III, the teacher is able to identify where a given student inquiring into a particular problem is in relation to the illustrative objectives for students learning to inquire. He is able to choose those teacher behaviors that facilitate the students' growth as inquirers. He also uses the process dialogue with his students before and/or after they work on a problem.

Goal Level IV
Generating Diagnostic Data About the Students' Behavior

At Goal Level IV the teacher uses those teacher behaviors through which diagnostic data may be generated about the students. He is able to generate these data both during an inquiry activity and during process dialogue.

Goal Level V
Inquiring into Teaching

At Goal Level V the teacher is able to inquire into instruction designed to help students grow as inquirers. He searches for more productive ways of behaving as a teacher and is skillful in helping other teachers understand and use inquiry as a way of learning and a way of teaching.

Illustrative Objectives for Teachers

The objectives for teachers learning to teach toward inquiry are classified according to the five goal levels just identified. These objectives become one basis for determining teacher attainment of the various goal levels.

The objectives do *not* include the conditions under which they should be attained, nor do they specify how well the teacher should perform. This information should be included, however, in the specific performance objectives formulated for each in-service workshop series.

The following list is intended to be illustrative, not comprehensive. It is not intended to outline teacher competencies in relation to all modes of teaching. Rather, it suggests a developmental sequence for teachers engaged in sharpening their ability to teach toward inquiry.

The specification of instructional objectives will probably not cure all the problems that face the educator, but then, what *single* endeavor will? The development of statements of objectives within any educational program usually contributes to a clearer description of the program. This is true whether we consider teaching toward inquiry in the classroom or an in-service series for teachers. A description of objectives for students may provide clearer identification of what we call an educated individual. This kind of description for teachers provides a basis on which teaching toward inquiry may be differentiated from other modes of teaching.

Illustrative Objectives for Teachers Learning To Teach Toward Inquiry

Goal Level I Reading the Students' Inquiry Behavior	**Goal Level II** Creating the Classroom Conditions for Inquiry	**Goal Level III** Facilitating the Students' Growth as Inquirers	**Goal Level IV** Generating Diagnostic Data About the Students' Behavior	**Goal Level V** Inquiring into Teaching
Classifies data-generating and data-using processes and problems for inquiry from a list of statements made and questions asked by students during an inquiry activity		**Classifies** a list of data statements into data about objects, events, systems of objects, conditions, people, places, and/or feelings	**Classifies** data from an audio or video tape of an inquiry activity into data about objects, events, systems of objects, conditions, people, places, and/or feelings	
Classifies data-generating and data-using processes and problems for inquiry from an edited tape recording of an inquiry activity				
Classifies data-generating and data-using processes and problems for inquiry from a kinescope or video tape of an actual inquiry activity				
Classifies data-generating and data-using processes and problems for inquiry from a tape recording of an inquiry activity in which he worked as an inquirer				
Relates the students' data-generating and data-using processes to the data–theory loop model of inquiry	**Classifies** data-generating, data-organizing, data-using, and theory-using processes from an audio tape or video tape of an inquiry activity	**Relates** the students' behavior to the illustrative objectives for inquirers	**Identifies** changes in the students' behavior in relation to the illustrative objectives for inquirers	**Predicts** changes that will occur in the students' work as inquirers
	Classifies teacher behaviors of the conditions set from an edited audio tape recording of an actual inquiry activity	**Classifies** teacher behaviors of the conditions and growth sets from an edited tape recording of an actual inquiry activity		
	Classifies teacher behaviors of the conditions set from a list of teacher's statements and questions drawn from an actual inquiry activity	**Classifies** teacher behaviors of the conditions and growth sets from a list of teacher's statements and questions drawn from an actual inquiry activity	**Classifies** teacher behaviors of the conditions, growth, and diagnostic sets from a list of teacher's questions and statements drawn from an actual inquiry activity	
	Classifies teacher behaviors of the conditions and growth sets from a kinescope or video tape of an inquiry activity	**Classifies** teacher behaviors of the conditions set from a kinescope or video tape of an inquiry activity		
	Creates teacher behaviors of the conditions and growth sets in response to a written list of students' statements and questions drawn from an actual	**Creates** teacher behaviors of the conditions set in response to a written list of students' statements and questions drawn from an actual inquiry activity	**Creates** teacher behaviors of the conditions, growth, and diagnostic sets in response to a written list of students' statements and questions drawn from an actual inquiry	

	Creates the conditions for inquiry in a simulated inquiry activity	**Creates** the conditions for inquiry and facilitates the students' growth in a simulated inquiry activity	**Creates** the conditions for inquiry, facilitates the students' growth, and generates diagnostic data about the students' thinking in a simulated inquiry activity.	
	↓	↓	↓	
	Creates the conditions for inquiry in his classroom	**Creates** the conditions for inquiry and facilitates the students' growth as inquirers in his classroom	**Creates** the conditions for inquiry, facilitates his students' growth, and generates diagnostic data about the students in his classroom	
	↓	↓	↓	
	Analyzes the student–teacher interaction patterns from a tape recording of an inquiry activity using the "T" system interaction analysis	**Reports** the effect of each teacher behavior in the growth set as immediate, latent, null, or negative from a tape recording of an inquiry activity	**Reports** the diagnostic data gleaned about the students as a result of using the diagnostic set of teacher behaviors	
	↓	↓	↓	
	Identifies tactical errors in using the conditions set of teachers behaviors	**Identifies** tactical errors in using the conditions and growth sets of teacher behaviors	**Identifies** tactical errors in using the conditions, growth, and diagnostic sets of teacher behaviors	
	↓	↓	↓	
	Uses the conditions set of teacher behaviors in working with his students on problems of different content areas and different classroom organizational patterns	**Uses** the conditions and growth sets of teacher behaviors in working with his students on problems of different content areas and different classroom organizational patterns	**Uses** the conditions, growth, and diagnostic sets of teacher behaviors in working with his students on problems of different content areas and different classroom organizational patterns	**Creates** problem situations suitable for his students' inquiry within the content areas of his present instructional program
	↓	↓	↓	
	Uses the conditions set of teacher behaviors in other than inquiry activities	**Uses** the conditions and growth sets of teacher behaviors in other than inquiry activities	**Uses** the conditions, growth, and diagnostic sets of teacher behaviors in other than inquiry activities	**Distinguishes** whether didactic, socratic, or inquiry is the suitable mode of teaching in terms of the objectives sought for the lesson
				Classifies teacher behaviors not of the conditions, growth, or diagnostic sets as other–consistent or other–inconsistent, from a tape recording or typescript of a lesson
				Redesigns socratic lessons into inquiry activities
				Rebuilds his instructional program to the degree that process objectives are included in all areas of the curriculum, e.g. math, social sciences, science, the arts, language arts
				Develops performance objectives for an in-service series in teaching toward inquiry
				↓
				Develops in-service strategies productive in helping other professionals sharpen their abilities to teach toward inquiry
				↓
				Participates as a leader in helping other professionals sharpen their abilities to teach toward inquiry

Appendix I

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First Classroom Interaction

We hope the following thumbnail sketch of an inquiry lesson will give you a feeling for what inquiry looks like with students. This particular activity was part of a unit in science.[1] The teacher used this lesson as an opportunity for his students both to apply concepts they had learned some weeks earlier about heat, change of state, and pressure, and to continue to develop their repertoire of theory-seeking and theory-testing strategies.

The teacher worked with a group of 12 students on the inquiry activity while a second group of 12 was watching a sound filmstrip related to the topic under study by the entire class and a third group of 12 was busy reading and carrying out some science investigations outlined in their textbook.

The teacher began work with the "inquiry group" after the other groups were at work. He planned to rotate the groups on following days so that all students would have a chance to participate in all three activities.

[1] This inquiry activity was first written up by Art Costa for *A Strategy for Science Instruction*, to be published by JS² Publishers, Hayward, Calif., in 1972.

Teacher Behavior	Student Behavior
"Today I'm going to show you a kind of science experiment. Then I'll pose a question about it. It will be your job to see if you can figure out how it works or why it works the way it does. OK?"	
"One thing I'll ask you to do is to raise your hand if you want to say something or ask some questions."	
The teacher holds up a pulse glass, a four-inch tube formed in a "U" shape. A one-inch glass globe is attached to each end of the "U" of the tube. One of the glass globes is partially filled with a red liquid. As he holds it so that all can see, he places his hand around this globe. The red liquid moves to the uncovered globe. He then places his other hand on the filled globe and takes his hand away from the empty one. The red liquid now moves back into the uncovered globe.	
"One question you might want to think about is why the red liquid moves."	
	Mike: "Is this thing a thermometer?"
"No."	
	Mike: "Does it work like a thermometer does?"
"It might."	
	Mike: "Hmm."

Teacher Behavior	Student Behavior
	Gina: "Do you squeeze it to make it go?"
"When you say 'squeeze it,' Gina, do you mean am I pressing in on the glass?"	
	Gina: "Yeah, I mean are you holding it real tight in your hand when it goes?"
"I'm holding it reasonably tight, but I'm not squeezing it real hard."	
	Gina: "Well, what makes it go, then?"
"That is your job. It's up to you to figure out what makes it go."	
	Maria: "Your hand's warm and that makes it go."
"Just a minute, Maria, I want to make sure that Gina is through. Gina, did you want to say anything else?"	
	Gina: "No."
"OK, now it's your turn, Maria."	
	Maria: "Well, is it?"
"Is what?"	
	Maria: "Is your hand warm?"

Teacher Behavior	Student Behavior
"Do you want to touch my hand so you can decide? Find out if it's warm."	
	Maria: "Sure. It's warmer than mine. Your hand is warm. Will it work with cold hands?"
"Do you want to try it to find out?	
	Maria takes the pulse glass and holds one side of it. The red liquid remains at the same level for a moment, but then moves slowly to the uncovered side.
	Maria: "Hey, it doesn't move as fast for me. Did you heat up your hand or something before you touched it?"
"No, I didn't."	
	Mike: "Can I try it too?"
"Sure. Maria, when you're through, would you please pass it to Mike?"	
	Maria: "In a minute, Mike, I'm not finished with my experiment yet."
	She places her other hand on the uncovered sphere and observes what happens. She turns the glass upside down and at several angles and observes the results.
	Maria: "Hey, I can make it run uphill!"

Teacher Behavior	Student Behavior
	Mike: "Let me try it now."
	Maria passes the pulse glass to Mike. He places his hands over both spheres. The red liquid does not move. He then places his hand around the tube connecting the two spheres. The red liquid does not move. Finally he places his hand over one sphere and the liquid moves to the uncovered side.
	Mike: "Is this stuff in here mercury?"
"No, it isn't."	
	Mike: "What is it?"
"Methyl alcohol."	
	Mike: "Methe . . . what?"
"Methyl alcohol."	
	Mike: "Well, could you use something else? Would it go with something else?"
"What would you like to use?"	
	Mike: "Water?"
"No, it wouldn't work if you used water."	
	Mike: "Is it the same stuff that's in thermometers? Ya' know, that red stuff?"

Teacher Behavior	Student Behavior
"No, it's not the same."	
	Mike: "Well, is that how it works? Does the stuff inside there expand when you heat it like a thermometer goes up when it gets hot?"
"Let me see if I understand you, Mike. You're saying the liquid in here expands—takes up more room—is that what you mean?"	
	Mike: "Yeah, it gets bigger; you put your hand over it and the heat from your hand makes the red liquid get bigger so it has to take up more room and it moves to the other side."
"Oh, you have a kind of heat theory or expansion theory about what makes it go. It's up to you to figure out if your theory is a good one.	
	Gina: "If you were to put it in some place real cold, would it work?"
"What do you mean by 'cold place'?"	
	Gina: "Like, if I could take it into a refrigerator, would it work there?"
"You mean if you were to do everything the same—put your hand over it just like I did—but you did it in a refrigerator, would it work the same?"	
	Gina: "Yeah."

Teacher Behavior	Student Behavior
"Yes, it would work the same."	
"OK, let's stop here for now. Before we go to lunch, though, let me ask what you think of what we have done today, and how you feel about it."	
	Gina: "Are you going to tell us the answer?"
"No. That's what inquiry is all about—learning how to decide for yourself if your answer is a good one."	
	Gina: "You mean you're not going to tell us?"
"No, but I want to make it possible for you to work so you can tell for yourself."	
	Mike: "I think you wanted us to figure out the answers for ourselves rather than you telling us the answer. Is that what you want us to do?"
"Yes, to learn how to figure out answers for yourselves. Do any of you feel that you do have a good theory?"	
	Frank: "Yes, I think it's heat."
"How do you know your theory is a good one?"	
	Frank: "Because it is. When you put heat on it goes. Or when you take heat away with ice or something cold it goes the other way."

Appendix II

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If the ideas outlined in this publication are to become general practice, the question of training the school staff must be considered. The authors of this publication have designed and conducted a 30-hour series designed to reach rather specific objectives in helping teachers develop skills in teaching toward inquiry. Readers will find the following schedule and other notes informative if they choose to move the ideas we have presented into formalized work with groups of teachers.

The series, which continues to be presented and redesigned,[1] is built on the following assumptions about inquiry:

Specific identifiable skills are required in teaching toward inquiry.

To teach toward inquiry requires experience as an inquirer.

The processes and products of inquiry are observable and can be classified.

One measure of growth as an inquirer is the degree of autonomy a student can assume in building and testing ideas.

It is possible to produce and identify inquirer growth.

There are specific, identifiable teacher behaviors that support the growth of inquirers toward behavioral objectives.

One measure of inquirer growth is how the student feels about himself in relation to the solving of problems.

A model of inquiry may be built from observable inquirer behaviors.

Specific teacher behaviors yield a predictable range of inquirer behaviors.

[1] For more recent modification of this strategy, the reader may write the authors at the Office of the Los Angeles County Superintendent of Schools, 155 W. Washington Blvd., Los Angeles, Calif. 90015.

. . . and on the following assumptions about in-service training:

A series should have prearranged structure with room built in so that individuals can influence the structure.

Experienced teachers have an operational set that facilitates or hinders growth in a specific behavior.

People learn to teach toward inquiry as a result of a wide variety of experiences.

Becoming a leader in training other adults requires special knowledge and skill.

Commitment to a change is essential to acceptance of it.

Involvement builds commitment.

For one to internalize a process, one must experience it.

There must be opportunities to practice the behaviors to be learned.

Participants must deal with obstacles in their own way.

Guidance in the effective use of a skill is essential to its implementation.

One further assumption is that there is a process growth sequence (intuitive-awareness-functional) through which both inquirers and teachers learning to teach toward inquiry progress.

Goals for the In-Service Series

To utilize in-service time most efficiently, specific activities were designed to reach identified goals. Goals for this series were as follows:

Goal Level	Goal
I	Read the students' inquiry behavior.
II	Create the classroom conditions for inquiry.
III	Facilitate the students' growth as inquirers.
IV	Generate diagnostic data about the students' behavior.
V	Inquire into teaching.

An Illustrative In-Service Time Line

Goal Level	Activity	Time	
	Registration.	30 min.	Hour 0
V	Orientation and point of view; the need for change.	60 min.	Hour 1
V	Inquiry demonstration lesson with children.	45 min.	Hour 2
I	Small groups build definition of inquiry from demonstration lesson.	30 min.	
I	Groups share definitions.	15 min.	Hour 3
I, II	Small groups of participants experience inquiry as students revise and add to their definition of inquiry.	75 min.	Hour 4
V	Participants identify obstacles to teaching toward inquiry in their classrooms.		

Goal Level	Activity	Time	
I	Small groups classify inquirer behaviors using prepared written materials.[2]	30 min.	Hour 5
	Administrative details (directions, questions).	20 min.	
I	Groups of five participants listen to a prepared tape of an inquiry lesson and classify the inquirer behaviors.	60 min.	Hour 6
I,II	Mini-lecture: the conditions set of teacher behaviors.	15 min.	Hour 7
I,II	Small groups experience adult inquiry.	30 min.	
I,II	Groups of 15 participants analyze the previous adult inquiry activity to classify the teacher behaviors and relate them to the students' behavior.	60 min.	Hour 8
I,II	Groups of three participants use prepared materials designed to enable them to create a teacher behavior that will establish the conditions of inquiry in response to given inquirer operations.	60 min.	Hour 9 Hour 10
I,II	Homework: teach for inquiry using the conditions set of teacher behaviors. Bring a 10-minute tape of the lesson to the next meeting.	30 min.	Hour 11
I,II	Groups of 15 participants discuss their experiences in teaching toward inquiry.	30 min.	
I,V	Groups of 15 participants experience adult inquiry with attention to the strategies they use as inquirers.	30 min.	Hour 12
I,II	Groups of five participants analyze tape recordings of previous adult inquiry activity: coding teacher and inquirer behavior.	20 min.	

[2] Strasser, Ben. B. *Learning To Teach Toward Inquiry*. Hayward, Calif.: JS[2] Publishers, 1970.

Goal Level	Activity	Time	
I,II	Choice time: (a) review tapes, (b) individual review of practice coding, etc.	15 min.	Hour 13
III	Mini-lecture: the growth set of teacher behaviors.	15 min.	Hour 14
I,II,III	Groups of five participants listen to a tape recording of an inquiry activity and classify the inquirer and teacher behaviors. Teacher behaviors of the conditions and growth sets are demonstrated.	60 min.	Hour 15
I,II,III,V	Groups of five participants use prepared materials to create an appropriate teacher behavior in response to given student behaviors. The groups role-play the responses to test the effect of teacher behaviors on others.	45 min.	
III	Homework: Read about the growth set of teacher behaviors. Read about demonstration lessons participants will use in their classrooms.	20 min.	Hour 16
I,II,III,V	Groups of five participants take turns simulating the teacher's role in teaching toward inquiry.	120 min.	Hour 17
	The participants discuss the feelings they had as they implemented the role of teacher.		Hour 18
I,II,V	Choice time—leaders review tapes made by participants.	20 min.	Hour 19
I,II,III,V	Groups of 15 participants experience adult inquiry with more work on developing their abilities as inquirers.	30 min.	Hour 20
I,II	Large group reads about "getting ready to teach for inquiry," checks out materials.	30 min.	Hour 21
II,V	Large group listens to humorous tape about inquiry, "Reflections of a Hawg Caller."	15 min.	

Goal Level	Activity	Time	
I,II,V	Homework: teach for inquiry using the conditions and growth sets of teacher behaviors. Bring a 10-minute tape of the lesson to the next meeting.	20 min.	Hour 22
III,V	Large group mini-lecture: "Getting Better at It."	10 min.	
II,III,V	Inquiry demonstration lesson with students.	30 min.	Hour 23
I,II,III,V	Groups of 15 participants analyze the previous inquiry demonstration with students to identify inquirer and teacher behavior.	30 min.	Hour 24
IV	Mini-lecture: the diagnostic set of teacher behaviors.	15 min.	
V	Choice time—watch video tape of an inquiry lesson; review prepared materials on teacher errors; review participant tapes with consultants.	60 min.	Hour 25
V	Large group discusses obstacles in teaching toward inquiry that were identified in Hour 4 and notes those that remain at the conclusion of 26 hours of in-service training.	20 min.	Hour 26
V	Large group lectures on three teaching strategies and a model of inquiry.	45 min.	Hour 27
I,II,V	Choice time—small groups meet to experience inquiry in eight different subject areas.	45 min.	Hour 28
I,II,V	Repeat of choice time activities; participants change groups.	45 min.	
I,II,V	Small groups meet to critique choice activities.	45 min.	Hour 29
II,V	Individuals and mini-groups work together to build problem situations for inquiry in selected subject areas.	40 min.	Hour 30
	Evaluation of the series.	60 min.	Hour 31
	Announcement of optional follow-up meeting.		

About the Authors

The ideas represented in this book are evolving as the six authors function as an in-service team, developing and presenting teacher training programs in inquiry. The teacher and learner behaviors described herein form the base of instructional objectives for four- to ten-day workshops using a variety of instructional materials and strategies developed by the team. These workshops have been sponsored by the USDESEA (U.S. Dependent Schools, European Area) under the auspices of the University of Southern California, by the California Teachers Association, and by numerous school districts in the western United States.

The authors bring a variety of disciplinary backgrounds to their work as a team. Ben B. Strasser is a consultant with the Office of the Los Angeles County Superintendent of Schools. He is author of *Molecules in Motion,* which is presently in use as a California State Supplemental Science textbook, and has been author and coauthor of several articles on the topic of inquiry. Bob Babcock is regional consultant specializing in program planning for the Office of the Los Angeles County Superintendent of Schools. He served for many years as an elementary school administrator. Ray Cowan is an elementary school principal in the El Rancho Unified School District. He has contributed to the California State Framework for Social Science, as well as to general curriculum development and program evaluation. Gus Dalis is a health education consultant for the Office of the Los Angeles County Superintendent of Schools. He has written several articles for professional journals on health education and was coauthor of *Health Education, Theory and Practice* and of *Decisions: A School Health Education Program.* Stu Gothold, also an author of *Decisions: A Health Education Program,* is assistant superintendent of education for the South Whittier Elementary School District. Jim Rudolph is director of the Program Planning Task Force of the Office of the Los Angeles County Superintendent of Schools. He also teaches courses in multimedia and instructional technology at the University of Southern California.

In addition to their in-service work in teaching toward inquiry, the team is developing an instructional sys entitled Toward Inquiry in Archaeol which includes three television grams, filmstrips, pictures, other bank materials, a teacher's gu and a copy of this book. William Fielder, professor of education Claremont Graduate School, and J Gothold, archaeologist and wife of of the authors, have also been w ing on the development of this uni study.

The archaeology project, as wel the publication of this book in its lier form (*Inquiry*), were made poss through the leadership of Richard Clowes, Los Angeles County supe tendent of schools; Maylon E. Dra assistant superintendent of edu tional programs and services; Grant E. Thayer, director of the D sion of Curriculum and Instructio Services.

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If you'd like to get a feeling for what the inquiry mode of teaching is all about, turn to "Why Inquiry?" (p. 7)

If you'd like to know more about the way people behave as they inquire, go to the section entitled "What Do People Do As They Inquire?" (p. 17)

If you'd prefer illustrations of specific teacher behaviors, see "Facilitating Inquiry in the Classroom." (p. 41)

If you're interested in examples of process objectives for students increasing their power as inquirers and for teachers perfecting their skills in teaching toward inquiry, go directly to "Objectives in Inquiry." (p. 67)

If you'd like to see a transcript of an inquiry lesson, turn to Appendix I. (p. 79)

If you're interested in an in-service series in teaching toward inquiry, turn to Appendix II. (p. 87)

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